

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
23 December 2004 (23.12.2004)

PCT

(10) International Publication Number
WO 2004/111065 A1

(51) International Patent Classification⁷: **C07F 15/00**,
9/02, B01J 31/00

(21) International Application Number:
PCT/GB2004/002426

(22) International Filing Date: 8 June 2004 (08.06.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0313709.8 13 June 2003 (13.06.2003) GB
0402416.2 4 February 2004 (04.02.2004) GB

(71) Applicant (for all designated States except US): **JOHNSON MATTHEY PLC** [GB/GB]; 2-4 Cockspur Street, Trafalgar Square, London SW1Y 5BQ (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DOMINGUEZ, Beatriz, Dominguez** [ES/GB]; 8 Russet Close, Bury St. Edmunds, Suffolk IP32 7HD (GB). **HEMS, William, Patrick** [GB/GB]; 2 Whitehouse Gardens, Poringland, Norwich, Norfolk NR14 7RG (GB). **ZANOTTI-GEROSA, Antonio** [IT/GB]; 44 York Street, Cambridge CB1 2PY (GB).

(74) Agents: **GIBSON, Sara, Hillary, Margaret** et al.; Intellectual Property Department, Johnson Matthey Catalysts, PO Box 1, Belasis Avenue, Billingham, Cleveland TS23 1LB (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

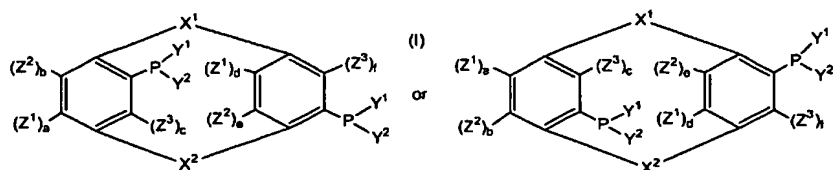
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: LIGANDS



(57) Abstract: A substituted paracyclophane is described of formula (I) wherein X¹ and X² are linking groups comprising between 2 to 4 carbon atoms, Y¹ and Y² are selected from the group consisting of hydrogen, halide, oxygen, nitrogen, alkyl, cycloalkyl, aryl or heteroaryl, Z¹, Z² and Z³ are substituting groups that optionally contain functional groups, a, b, c, d, e and f are 0 or 1 and a + b + c + d + e + f = 1 to 6. Preferably X¹ and X² are -(C₂H₄)- and a + b + c + d + e + f = 1 or 2. The substituted paracyclophane provides transition metal catalysts that demonstrate high activity and selectivity for asymmetric reactions.